CH1012 Tutorial 3 Answers

1. Name the following compounds:

Na[Co(en)Br ₄]	sodium tetrabromo(ethylenediamine)cobaltate(III)
Na ₃ [CoF ₆]	sodium hexafluorocobaltate(III)
$[Mn(en)_2(OH_2)_2]^{2+}$	diaquabis(ethylenediamine)manganese(II)
[Mn(H ₂ O) ₅ Br]SO ₄	pentaaquabromomanganese(III) sulphate
[Cr(NH ₃) ₄ (CN)Br]Cl	tetraamminebromocyanochromium(III) chloride
[Ru(bipy) ₃](NO ₃) ₂	tris(bipyridyl)ruthenium(II) nitrate

2. Draw structures of the following complexes and identify those that may exist as geometric isomers:



3. In metal complexes the ligands which are attached to the metal centre may be classified as either **monodentate** or **polydentate**.

• What do these terms mean and explain the key features of a polydentate ligand using a trien metal complex as an example - include the **donor atoms** and the **chelation effect** in your answer.

Ligands are classified according according to how many donor atoms are involved in simultaneous bonding with the TM ion. (Latin "dent" tooth)

Monodentate:1 donor atom / siteCl⁻Polydentate:3 or more donor atoms / sites.Trien, 3 N donor atoms.

Polydentate ligand

trien {= $NH_2CH_2CH_2NHCH_2CH_2NH_2$ },



4. Describe the bonding in transition metal coordination complexes using a Lewis acid / Lewis base description of **coordinate covalent bonding**.

A Lewis acid is a 2 electron acceptor atom and a Lewis base a 2 electron electron donor atom. The bonding in TM coordination complexes may be thought of as a result of coordinate covalent bond interactions between Lewis base ligands (2 electron donors such as :NH₃, H₂O:, :CO, Cl⁻...) and the transition metal ion which behaves as a Lewis acid as a result of vacant d orbitals. The 2 electrons in each coordinate bond come from the ligand but are shared with the TM ion.

eg. Zn^{2+} Lewis acid, NH₃Lewis base, $[Zn(NH_3)_4]^{2+}$ Zn \leftarrow :NH₃

5. What is **hemoglobin** and how does it function at a molecular level as an oxygen transport protein?

Hemoglobin is a metalloprotein that at the quaternary level of structure is seen to contain 4 globin subunits. Each globin unit contains a heme centre encapsulated in a globular protein. The heme centre is composed of an iron atom coordinated to a porphyrin ring (4N's) and an atom of the protein chain (N His) and either $O(H_2O)$ or $O(O_2)$ occupying the 6th position in the coordination sphere.

$L_5Fe(H_2O) + O_2$	⇆	$L_5Fe(O_2) + H_2O$
lungs		tissue undergoing aerobic respiration
$Hb(H_2O)_4 + 4O_2$	⇆	$Hb(O_2)_4 + 4H_2O$
blue deoxyhemoglobin in venous blood		red oxyhemoglobin in arterial blood
H ₂ O weak field		O_2 strong field